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THE INITIAL SYMPTOMS AND EARLY DIAGNOSIS OF TUMOR OF THE BRAIN*

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Theoretically the sooner a tumor of the brain is recognized and the patient treated, the more favorable as a rule should be the effect of therapy. Unfortunately, such is not always the case. In this study it was found that poor therapeutic results were obtained in many of the individuals in whom the tumor was recognized shortly after the onset of the disease, whereas operative successes were prevalent in patients with clinical history of long duration. This is a paradox, but it can be resolved to some extent if each case of tumor of the brain be considered individually. It must be remembered that the life cycle of a cerebral neoplasm which is encapsulated is longer than one which is infiltrating, so that when a tumor is discovered three months after the first symptom appears, the diagnosis is considered to have been made early in the case of a meningioma but late in the case of a spongioblastoma multiforme. Again the term "early diagnosis" is a relative one and depends on the element of time; the time referred to is the interval between the onset and the recognition of the disease. This clinical interval is determined by such variable factors as rate of growth, histological nature, location and size of the tumor, as well as by the age and general condition of the patient.

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How early can a tumor of the brain be discovered? It can be recognized as soon as there are symptoms, and when the severity and disabling nature of the complaints bring the patient to the physician. The symptoms usually emphasized as the most important manifestations of tumor of the brain are headache, nausea, vomiting, and choked disc. With the possible exception of headache, these denote intracranial hypertension and usually appear late in the course of the disease. When such manifestations exist they are significant, but in order to enable one to make an early diagnosis in these cases, it is essential to be well acquainted with the early symptoms of tumor of the brain. It is well known that evaluation of complaints at the onset of an illness is extremely difficult, so that with a paucity of physical signs from which to judge, and in the absence of papilledema, the physician may not be inclined to make a diagnosis of intracranial tumor, even though he may suspect it. What usually happens is that unless the symptoms are discomforting, the reluctant patient and the puzzled doctor refrain from further investigation until additional manifestations appear. This is especially true in cases of neoplasms involving the so-called "silent areas."

In this communication, attention will be directed particularly to the early part of the clinical course, especially to the initial symptoms and physical signs noted on the first admission to the hospital. For this purpose and for the sake of convenience in calculating percentages, the case histories of the last one hundred histologically verified neoplasms were reviewed.* The study was facilitated by arranging the records according to the duration of complaints from onset until the time of the first admission to the hospital; the shortest period was ten days (Case No. 1) and the longest period nineteen years (Case No. 100). These were then divided into groups, with an approximately equal number of cases in each. (See tables.)

* A majority of the facts cited in this review were based on a series of 500 patients examined at the Mount Sinai Hospital for intracranial tumor, which was verified by operation or necropsy or both.

When classified in this manner, it was found that most cases of tumor of the brain revealed a history of relatively brief duration. At the same time it was noted that a majority of these neoplasms were of the rapidly developing and infiltrating variety; when the neoplasm was encapsulated, the clinical course was prolonged.

GROUP I

(Duration of symptoms from onset until first admission to the hospital:—one month and less)

Cases belonging to this group have been described as "acute brain tumors." The onset was abrupt, symptoms severe, and the course, at times simulating an acute systemic disease, rapid. A few patients were referred to the hospital as emergency cases because their cerebral manifestations were extraordinarily violent. In several instances the course was so rapid and fulminating that there was not sufficient time for confirmatory investigations. Five of them ceased before any operative interference could be undertaken.

Thirteen of the seventeen tumors in this group were of the infiltrating spongioblastoma multiforme variety, and supratentorial in position. Because these neoplasms expanded rapidly, the organism did not have sufficient time to accommodate for the rather sudden changes in intracranial equilibrium. Consequently, new manifestations evolved within a few days, or even hours after the onset of symptoms. It was not surprising also to find that in some patients papilledema developed over night. When several symptoms appeared in rapid succession, it was almost impossible to distinguish as to which one of them came first, so that they all seemed primary. This relative multiplicity of initial complaints was found to be most prevalent in patients with histories of brief duration. In these instances the tumor was recognized "early" because there were enough symptoms and signs upon which to base a diagnosis, and the histories, therefore, were short.

In this group, the most prominent initial symptom was headache, which was often distressing and paroxysmal in character. Mental changes and disturbances in speech due

to aphasia were next in order of frequency. Physical signs, present in all but one instance, were meager, and except for aphasia were of little localizing value. Papilledema occurred in twenty-four per cent of the cases. This low incidence may be explained by the fact that the tumor with a short clinical history, although causing profound subjective complaints, did not expand sufficiently to produce choking of the optic nerves.

The following cases are examples of the so-called acute brain tumors. Despite the fact that they were diagnosed at the earliest possible period, the therapeutic results were poor (Table III). The unfavorable results were due to the fact that the tumors were histologically malignant. Surgical therapy in some of these patients prolonged life for several months, but these afflicted individuals were as a rule helpless, so that in reality the gains derived from therapy were nil.

SERIES CASE NO. 5—A.P.—A twenty-nine-year-old male was referred to the hospital with a diagnosis of suspected brain tumor. He was in good health until two weeks ago, when there developed dizziness. Three days before admission he complained of severe frontal headache which became progressively worse. The following day, he vomited several times, and on the day before admission he became irrational, talkative, and unmanageable.

Examination revealed a well-nourished man who appeared acutely ill and toxic. Temperature 100° F. Pulse 66. He was extremely garrulous, boisterous, and emotionally unstable. He was violently restless, requiring mechanical restraints to keep him in bed. He was totally confused and disoriented in all spheres. His memory for remote and recent events was severely impaired. There was a slight rigidity of the neck, and slight tremors of outstretched hands. Lumbar puncture showed an initial pressure of 180 to 200 mm. of water, and six cells per cu. mm.

The patient became progressively drowsy. Intravenous injection of hypertonic glucose solution and a repeated thecal puncture yielded no improvement. The spinal fluid obtained on the second examination, four hours after the

first tap, was under an initial pressure of 220 mm. of water and contained 140 polymorphonuclear leucocytes per cu. mm. Declining rapidly and in the midst of a preparation for an emergency subtemporal decompression, the patient suddenly became cyanotic and died, twenty-four hours after admission to the hospital.

Autopsy revealed a colloid cystic tumor 7.5 mm. in diameter, involving the septum pellucidum.

COMMENT: Although the tumor was small and histologically benign, the clinical history was acute and rapid. The symptoms were due to the location of the neoplasm, the latter being "silent" until it blocked the flow of cerebrospinal fluid, causing an acute internal hydrocephalus. The clinical course, especially during the last twenty-four hours, was so fulminating that there was not sufficient time to confirm the suspicion of an unlocalized expanding intracranial lesion. Brain tumor was surmised because of the organic mental picture associated with severe headache and dizziness. There is no doubt that these symptoms may also occur in meningitis. In fact, the latter was considered in the differential diagnosis, and was excluded only after the first examination of the spinal fluid, although the pleocytosis on second examination revived the diagnosis of a possible meningitis.

In this particular instance it was almost impossible to make a diagnosis of intracranial tumor at any earlier period, although early surgical intervention might have been successful because the tumor was small and histologically benign.

SERIES CASE No. 6 — P.B. — A twenty-eight-year-old French business man was admitted to the hospital with the history that during the last two weeks it was noted that he had lapses of memory for his trade sales prices and difficulty in rapid calculation. Shortly thereafter, the patient's wife observed that he spoke to her in English, and spoke French at his place of business. This was the reverse of his customary speech habits. One week ago he vomited, and on the following day he had a period of confusion. He was found standing under a shower bath, clad in pajamas

and bath robe, gazing vacantly about him, totally unaware of his surroundings. The family doctor advised observation at a mental hospital for an impending psychosis. When the patient applied to the Bellevue Psychiatric Hospital, he presented no obvious mental symptoms and was advised to go home. Two days later, he was unable to answer questions for a few seconds. He simply remarked that his mind was blank. He was seen by one of us, and despite negative physical findings was referred to the Mount Sinai Hospital with the diagnosis of "probable tumor of the brain."

At the hospital, neurologic investigations gave negative results. During the examination it was noted that the patient had transient episodes in which he was entirely unable to speak, and his mind, as he said, had "gone blank." The examiner described these episodes as being similar to catatonic states. When the patient was asked to write his name, he scribbled something in French which was irrelevant. A few hours after admission, there developed a series of convulsions, and he died in a status epilepticus twenty-four hours after entering the hospital.

Autopsy revealed a ganglioglioma of the left prefrontal lobe.

COMMENT: Obviously, the diagnosis was difficult. At first the patient was suspected of suffering from an expanding intracranial lesion, and not until convulsive seizures appeared was the diagnosis of cerebral neoplasm confirmed. The chances of an earlier diagnosis in this patient were unlikely, because the entire symptomatic period was so short. This is another example in which the rapid clinical course suddenly terminated fatally, and before any therapy could be instituted.

SERIES CASE NO. 7—H.B.—A fifty-year-old storekeeper was admitted to the Neurologic Service complaining of headache. Perfectly well until two weeks before admission, there suddenly developed headache, and he found that he was unable to express himself clearly. The speech difficulties, transitory in character, recurred at irregular intervals and became bothersome and irritating. Between attacks he was free of symptoms. After one week the headaches returned and again disappeared. In the last twenty-

four hours the pains in the head returned, this time accompanied by a persistent handicap in his speech. He was unable to answer questions, to concentrate, or to do simple arithmetical problems. He did not seem to understand what was asked of him. His memory for recent events became impaired. Seven hours prior to admission he complained of numbness in the right arm which spread one hour later to involve the lower extremity on the same side. During the last twenty-four hours he became progressively drowsy.

On admission to the hospital, the systemic examination was essentially negative. Blood pressure 130/88. Aphasic status revealed a mixed aphasia, predominately sensory in character. He made vain efforts to obey complicated commands. He was embarrassed and exasperated by his aphasia, because it made him feel that he "must be a dummy." He was restless, apprehensive, and irritable. The neurologic status revealed a faint hemiparesis and increase in the deep reflexes on the right side. The rest of the examination gave negative results.

COURSE: On the day after admission there was a marked improvement in symptoms, the only remaining physical sign being a slight anomia. Twenty-four hours later, the slight aphasia disappeared and the patient became practically "normal."

The clinical diagnosis was tumor of the brain, but with the marked and rapid improvement and complete disappearance of signs, it was soon changed to thrombosis of a branch of the left middle cerebral artery, although a neoplasm involving the left temporal lobe was still entertained. He was discharged and observed in the follow-up clinic for three months, during which time he had no complaints. Three and a half months after he left the hospital, there developed headache and he became drowsy and depressed. This lasted for two and a half days, after which he suddenly improved and became cheerful and again free of symptoms. On the night before admission, he felt sleepy, and on the following morning he could not be aroused.

The patient was readmitted in a comatose state. An emergency exploratory craniotomy was negative. Autopsy

twenty-four hours later revealed a spongioblastoma multiforme involving the posterior subcortical portion of the left temporal lobe.

COMMENT: This case illustrates the possibility of complete remissions in the course of a brain tumor. A more familiar example of remissions in symptoms is the periodic attack of convulsive seizures and the relative freedom from symptoms between attacks. In this series of one hundred intracranial neoplasms, the most striking feature in the histories was that the course was intermittent. An improvement or complete remission in a patient suspected to be suffering from a tumor of the brain should not alter the original suspicion.

SERIES CASE NO. 17—F.C.—An Italian male, aged forty-six, was admitted to the Neurologic Service with the history that for the last eight years he had suffered from pain in the lower back, and for the last two or three years he had had cramps in his legs. Except for the above complaints, he had been well until four weeks before admission, when there developed severe and persistent headache. The following week, there suddenly developed weakness and numbness in the right upper limb. In addition, he complained of periodic twitchings of the right hand and corner of the mouth, associated with momentary losses of speech. During the week prior to admission, weakness in the right arm became more pronounced, he had difficulty in expressing himself, and, in the last few days, gradually became drowsy.

On admission, the patient was apathetic. A few spontaneous jerky movements were noted in the left face and upper extremity. There was slight rigidity of the neck, and a suggestive positive Kernig sign. Despite the fact that the patient was drowsy, irritable, and resistive to examination, it was possible to elicit a mixed aphasia. There was a hemihypalgesia and flaccid hemiplegia associated with pyramidal tract signs on the right side. The optic discs showed questionable edema. The right pupil was irregular and greater than the left. Both reacted sluggishly to light and well in accommodation.

The clinical diagnosis was neoplasm of the left cerebral hemisphere. Syphilis was suspected only because of the pupillary signs.

A lumbar puncture showed xanthochromic fluid under an initial pressure of 180 mm. of water. There was no block to jugular compression. The fluid contained traces of globulin; total protein 180 mgms. per 100 c.c.; and 7 lymphocytes per cu. mm. The Wassermann and Kahn reactions of the blood were four plus; spinal fluid Wassermann one plus; colloidal gold curve 22233321110.

With these serological tests, the diagnosis of tumor of the brain became less certain, although it was still entertained. Since there was a possibility that lues might present such a clinical picture, the patient was subjected to antiluetic therapy, to note whether any improvement might take place. The ultimate intention was to operate for a neoplasm, but the patient died suddenly, twelve days after admission.

Autopsy revealed a glioblastosis with spongioblastomatosis of the left cerebral hemisphere.

COMMENT: Clinical judgment prompted what proved to be the correct diagnosis: cerebral neoplasm. The positive Wassermann reactions complicated and temporarily hindered the contemplated surgical intervention. Although syphilis may simulate any disease process, it is uncommon for a symptom-complex such as this patient presented to be caused only by spirochetal infection. Severe headache with well localized cerebral signs and symptoms should always prompt the suspicion of a tumor of the brain, even in the presence of serological evidence of lues. In this series of one hundred cases, four patients had an unequivocal history of syphilis. In two instances, the diagnosis of brain tumor was delayed because clinical judgment was allowed to be superceded by laboratory findings.

GROUP II

(Duration of symptoms from onset until first admission to hospital:—over one to two months)

Except for the fact that the duration of the clinical course in this group was longer than in Group I, the symp-

tomatology was practically the same. The pathology in the two groups differed insofar that the number of gliomas in the second group was less than in the first, the discrepancy being caused by tumors of the sarcoma and metastatic carcinoma types. The spongioblastic neoplasms here were discovered later than those in Group I. The explanation for the postponement in diagnosis in these instances may be that diffusely infiltrating tumors sometimes attain large dimensions and yet produce symptoms insufficiently outstanding to attract early attention; the tumors continue to expand until, due possibly to a sudden increase in the intracranial pressure, there results an increase in objective and subjective symptoms, making the diagnosis of tumor of the brain obvious. Another reason for the delay in diagnosis is that aphasia was less frequent here and in subsequent groups than in Group I. (Table II and Fig. I.)

Aphasic manifestations, even if minimal, are usually intimidating enough for the patient to seek early medical advice. The better trained physician, in turn, recognizes the aphasia, and without further delay proceeds to search for its etiology, consequently making an early diagnosis possible. It may also be that although aphasia plays a significant role in the early recognition of tumor, in its absence there are other manifestations which, if distressing enough, will rouse the prompt attention of the patient and the physician. In the event that there is no aphasia, the neoplasms continue to develop and become evident through severe headaches, mental changes, motor weakness, or, at a later date, papilledema.*

* A higher incidence of choked disc was noted in patients with tumors unattended by aphasia, as compared with those in whom aphasia was present. This observation was derived from a study of 150 cases of tumors which involved either the right or the left cerebral hemisphere. Of these, 112 patients did not present speech disturbances either in the history or at the examinations on admission to the hospital; the remaining 38 patients did. Among the cases without aphasia, the incidence of papilledema was 58 per cent, whereas in cases where aphasia was manifest, the incidence was 40 per cent.

FIGURE I

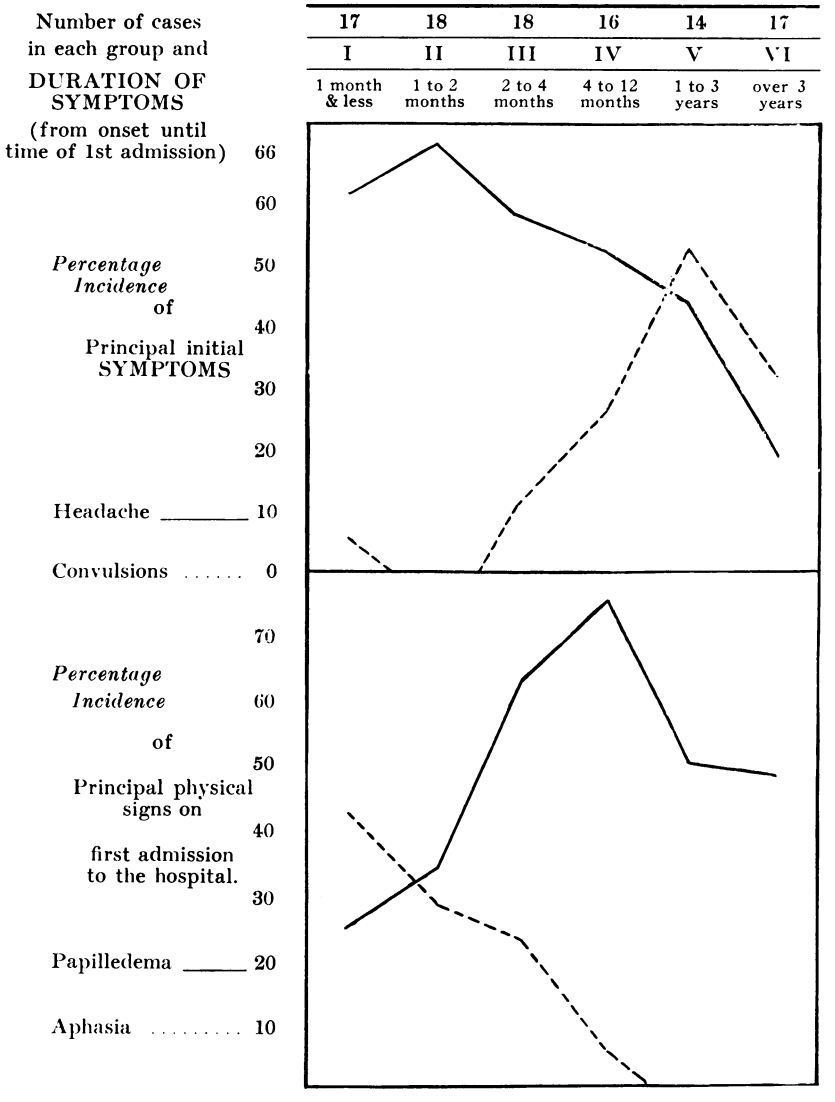

Figure I illustrates graphically the reciprocal relation which was found to exist between the percentage incidence of the initial symptoms headache and convulsions, and between the percentage incidence of papilledema and aphasia observed on the first admission to the hospital.

As in Group I, headache was again foremost among initial complaints. In fact, the incidence of its occurrence was even more frequent. As regards the physical signs, it has already been mentioned that the incidence of aphasia was declining, whereas that of papilledema was reciprocally on the increase. (See Fig. I.)

The following case illustrates the difficulties involved in the diagnosis of tumor when the physical signs are meager. The tumor was located in the right hemisphere, and since the patient was right-handed, aphasia was not present; the disease, therefore, was allowed to progress until choked disc appeared.

SERIES CASE No. 19—B.H.—A twenty-six-year-old housewife was admitted with the history that during the last four and a half weeks she had experienced intermittent attacks of severe headache. Three weeks before admission she vomited several times, and since then had occasionally felt drowsy.

Physical and neurologic examinations gave negative results. The patient was suspected of having a tumor of the brain, but no definite diagnosis could be established. Lumbar puncture showed an initial pressure of 110 mm. of water. An encephalogram was performed, but no air was visualized in the ventricles. While in the hospital, she continued to vomit and to complain of severe headaches. Two weeks after admission, slight blurring of the disc edges was noted, and a few days later frank papilledema and a left facial weakness appeared. A second air study, this time a ventriculogram, was also unsuccessful. Finally an exploratory craniotomy revealed a microglioma involving the posterior and inferior portions of the right frontal lobe.

COMMENT: This case illustrates the difficulty of recognizing neoplasms located in the so-called "silent areas." The patient was suspected to be suffering from tumor because of the severity and paroxysmal nature of the headaches, associated with vomiting and drowsiness. There were no localizing signs and no objective evidence of intra-

TABLE I

	GROUP		I	II	III	IV	V	VI	
	Duration of symptoms from onset until first admission . .		1 month	1 to 2 months	2 to 4 months	4 to 12 months	1 to 3 years	over 3 years	TOTAL
Tumors located above the tentorium (a) Single lobe	Frontal	left	2	1	3	2	1		9
		right					1		1
		both	1	1					2
	Temporal	left	3	1	3		3	1	11
		right	1	1		1		1	4
	Parietal	left	1		1				2
		right	1						1
	Occipital	left				1			1
		right					1		1
(b) Combination of lobes	In one hemisphere	left	3	3	4	1	2	1	14
		right	2	2	3	3		3	13
	In both hemispheres	multiple	1	4	1	2		1	9
(c) Periventricular	Region of 3V. and pituitary body.	midline	1	2		2		5	10
	TOTAL SUPRATENTORIAL TUMORS		15	15	15	12	8	12	77
Tumors located below the tentorium	Cerebellar		2	3	3	4	1	2	15
	Cerebello-pontine angle . . .						5	3	8
	TOTAL INFRATENTORIAL TUMORS		2	3	3	4	6	5	23
	GRAND TOTAL		17	18	18	16	14	17	100

Table I illustrates the distribution of the tumors in each group as to location within the cranial cavity and brain.

cranial hypertension. To confirm the presence and location of the cerebral growth, pneumoroentgenograms of the skull were performed, but unfortunately the ventricles were not visualized, so that operation was delayed until physical signs appeared; i.e. choked disc and left facial weakness. Unless the subjective symptoms are properly evaluated and x-ray studies employed, the absence of objective signs frequently prevented the early diagnosis of tumor of the brain.

GROUP III

(Duration of symptoms from onset until first admission to hospital:—over two to four months)

This group was composed partly of malignant neoplasms which were recognized late in their course, and partly of benign tumors discovered relatively "early." Included among the malignant variety were the spongioblastoma multiforme, the less malignant transitional cell gliomas, and the metastatic carcinomas; among the benign or encapsulated tumors were those of the meningioma group (Table III.) The diagnoses in all of these instances were hindered because the primary symptoms were not as severe nor as manifold as in the "acute brain tumors." In the incipient stages of the disease, either the patient hesitated to consult the doctor or, when examined, did not exhibit objective signs significant enough to warrant a diagnosis.

Headache, again the most common primary symptom, was not as painful nor as frequent in occurrence as in the former groups. (See Table II.) Despite the fact that ten of the tumors were situated in or about the speech center (Table I), disorders of speech were relatively uncommon. Aphasia did appear in a few of the latter instances, but became evident only after admission to the hospital. As if to replace the lack of this valuable diagnostic sign, there was a rise in the incidence of choked disc, and the major portion of this increase, in this as well as in the next group, was contributed by the infiltrating gliomas. (Tables II, III; Fig. I.) In other words, the tumors expanded until they became manifest either by early appearance of aphasia or by late development of papilledema. There were other

TABLE II

	Group	I	II	III	IV	V	VI	Total
Principal Initial Symptoms	Number of patients in each group	17	18	18	16	14	17	100
	Duration of symptoms (from onset until first admission)	1 month and less	1 to 2 months	2 to 4 months	4 to 12 months	1 to 3 years	over 3 years	
	Headache	59	66	56	50	42	18	48
	Convulsions	6		11	25	50	30	20
	Mental changes	35	33	6		7		15
	Visual disturbances (diplopia—poor vision)		17	17	25		30	14
	Speech difficulties (aphasia)	29	28	11				11
	Dizziness	12	11	11		7		7
	Motor weakness, paresthesias		11	22	6			6
	Deafness, tinnitus					13	23	6
	Vomiting		11	11				4
	Endocrine dysfunctions						18	3
	Unsteadiness in gait				13			2
Principal physical signs on first admission to the hospital	Papilledema	24	33	63	75	50	47	48
	Aphasia	42	28	22	6			16

Table II illustrates the percentage incidence of the principal initial symptoms and of papilledema and aphasia observed on the first admission to the hospital in each group.

signs, such as defects in the visual fields, facial weakness, and reflex changes, which, if discovered early and properly evaluated, might have led to an earlier diagnosis. Unfortunately, however, such was not the case, because most practitioners are inexperienced in testing the perimetric fields, in evaluating a slight difference in reflexes, or in interpreting the significance of a poor plantar response when testing for a Babinski sign. Some of them may ignore the value of many essential neurologic tests and the slight variations in physical signs which the patients may exhibit, and concentrate chiefly upon the eye grounds to look for papilledema. When they do not find papilledema, they disregard the history and whatever physical signs there are, and exclude the possibility of tumor of the brain in the diagnosis of the disease.

The following case history is an illustration of a malignant neoplasm not recognized until late in the course of the disease.

SERIES CASE NO. 37—R.C.—A female, aged fifteen, was admitted with the history that nine weeks prior to admission she suffered severe headaches, vague abdominal pains, and vomiting. A physician attributed the malady to chronic appendicitis. Five weeks later there developed an internal ocular squint. Despite this eye symptom, an appendectomy was performed on the patient because of the persistence of the abdominal symptoms. Following the operation, she became drowsy, continued to be nauseous, and vomited. Three weeks before admission there developed diplopia and fine tremor of the right hand. Two days before admission she complained of severe headaches and dizziness, had two generalized convulsions, and became increasingly stuporous.

Examination revealed an undernourished female in deep stupor. Spontaneous twitchings in the right face were noted. There were a spastic hemiparesis and concomitant pyramidal tract signs on the right side, bilateral high grade papilledema, and a stiff neck. A spinal tap showed increased fluid pressure with 52 lymphocytes and 140 R.B.C. per cu. mm.

TABLE III

GROUP	I	II	III	IV	V	VI	
DURATION OF SYMPTOMS (from onset until first admission)	1 month	1 to 2 months	2 to 4 months	4 to 12 months	1 to 3 years	over 3 years	TOTAL
GLIOMA	13	9	11	6	4	4	47
MENINGIOMA	1	1	3	8	5	3	21
METASTATIC CARCINOMA AND SARCOMA	2	6	4	1		1	14
NEUROFIBROMA					4	3	7
PITUITARY ADENOMA		1				5	6
MISCELLANEOUS	Colloid Cyst 1	Tuberculoma 1		'Craniopharyngioma 1	Tuberculoma 1	Cholesteotoma 1	5
NUMBER OF CASES IN EACH GROUP	17	18	18	16	14	17	100
NUMBER OF PATIENTS OPERATED UPON	12	14	16	16	13	16	87
NUMBER OF PATIENTS SURVIVED 1 YEAR OR MORE AFTER OPERATION	0	2	3	4	5	6	20

Table III illustrates the distribution of the tumors in each group as to type and as to operative results.

An emergency right subtemporal decompression was performed. The patient died on the day after admission to the hospital. Necropsy disclosed a spongioblastoma in the left thalamic region.

COMMENT: This patient had at least two definite cerebral symptoms which should have aroused the suspicion of intracranial disease: at first, attacks of severe headache, and later, ocular squint—both of which are common in the course of a tumor of the brain. The abdominal pain, which apparently was erroneously attributed to chronic appendicitis, may also have been due to the tumor of the brain. Disease in the region of the basal ganglia may sometimes produce pain simulating gall bladder or appendiceal disease. Not until other and more intense cerebral symptoms appeared was intracranial pathology suspected, and by the time the patient was transferred to the Mount Sinai Hospital it was late in the course of the illness. The diagnosis was delayed because too much reliance was placed on the abdominal complaints, which in retrospect were actually of cerebral origin, whereas little or no attention was paid to symptoms such as headache and ocular squint.

GROUP IV

(Duration of symptoms from onset until first admission to hospital:—over four to twelve months)

Here, the initial complaints, fewer in number, were insidious in onset and less annoying to the patient. Coming to the foreground as early symptoms of intracranial tumor, in this and in the subsequent groups, were convulsive seizures. The attacks, usually in the disguise of epileptic equivalents, were transient, infrequent, and not sufficiently disturbing for the patient to seek immediate medical attention.

Physicians are well aware that convulsions or their recognized equivalents usually imply disturbed intracranial function. They also know that convulsions are frequently caused by tumors of the brain, and that one way in which the latter may be excluded is by intracranial air injections. The physician may consider encephalogram as

an aid to diagnosis, but to urge a reluctant patient to submit to such studies is difficult for two reasons: In the first place, a patient with a brain tumor who has as the only symptom convulsive seizures may feel perfectly well between attacks. He refuses to admit that he may be ill, and shuns the suggestion that he enter the hospital, though it be merely for observation. The doctor, on the other hand, who does not find objective signs to verify his suspicion of intracranial tumor, is not inclined to press the patient too firmly, especially when the patient feels comfortable and protests that he is "not sick." Consequently, the neoplasm continues to expand, and only when additional manifestations appear does the problem demand solution. As previously stated, this indecision and procrastination probably accounts for the increasing incidence of papilledema in patients with "delayed" diagnoses.

As each group was studied, it became evident that the longer the clinical course the more probable it was that the tumor was benign. Eight of the neoplasms in this group were of the meningioma variety (Table III).

The following case history is an example of how the diagnosis of an intracranial neoplasm may be delayed when the optic fundi reveal no papilledema.

SERIES CASE NO. 64—J.B.—A male, aged seventeen, complained that ten months before admission he saw double on looking to the left. The patient consulted an optician and was told that his vision was good. To avoid the diplopia, the patient postured his head to the right and rotated it slightly to the left; except for this abnormality, he felt well. Six months later, there developed severe occipital headache and unsteadiness in gait for which he compensated by walking on a wide base. This time he consulted a physician, and was told that he had encephalitis; he was treated for the latter, but without effect. Later he was treated for multiple sclerosis. Not until nausea, vomiting, and dizziness appeared, ten days before admission, was a tumor of the brain suspected.

On admission the patient complained of severe throbbing headache, which throbbing was synchronous with his pulse

beat. The gait was unsteady and broadbased, coordination movements were poor in the left upper and lower extremities; there was dysdiadokokinesis on the left; diplopia on looking to the left; marked nystagmus in all directions; and normal optic fundi. He was somewhat anxious, slightly overtalkative, and perhaps euphoric.

The clinical diagnosis was hemangiomatous tumor of the left cerebellar lobe. Ventriculogram showed a marked symmetrical internal hydrocephalus. Craniotomy revealed a large cystic hemangio-endothelioma in the left cerebellar hemisphere, with a mural nodule the size of an English walnut.

COMMENT: The diagnosis was delayed because the patient was not sufficiently inconvenienced to seek medical aid. When he did consult a physician, the condition was not recognized because the patient did not have papilledema. The absence of papilledema was considered a factor against the diagnosis of tumor of the posterior fossa. It must be emphasized that choked disc is a late sign of intracranial tumor, and that it is not necessary to await its appearance in order to establish the correct diagnosis. The ventriculogram in this case demonstrated that there may be marked internal hydrocephalus due to intracranial hypertension, without there being concomitant papilledema. Because papilledema was absent in the early course of many cases of tumor of the brain, an erroneous diagnosis was not infrequently made; in the young individual, the most frequent erroneous diagnosis was encephalitis, and in the aged it was cerebral arteriosclerosis.

GROUP V

(Duration of symptoms from onset until first admission to the hospital:—one to three years)

In this group, the early symptomatology was even more indefinite than in the previous groups, and the course was characterized by long remissions and chronicity. As a primary symptom, headache was usually not intolerable and did not recur for long intervals. Continually increasing in incidence, convulsive seizures became equally as frequent as headache. Six of the eight patients with supra-

tentorial neoplasms had epilepsy or its equivalent as their first symptom: two of them had generalized convulsions, and the remaining four complained of cramp-like seizures localized to one side of the body or attacks of syncope.

It was noted that in this and the next group, tumors of the cerebellopontine angle were common. The physical signs on admission were those expected in growths implicating the eighth cranial nerve and adjacent structures, and the tumor was therefore easily localized. Also, the initial symptoms and subsequent prolonged course implied a disease process referable to the hearing apparatus. Since the symptoms and signs were persistently focal in character, one would have expected that these tumors be discovered early. Such, however, was not the case; these patients complained of tinnitus or of varying degrees of deafness for long periods before the neoplasms were recognized. Could it be due to the fact that slow-growing tumors manifested themselves at a gradual rate? Or is it because physicians neglected to test the vestibular and cochlear functions?

It is possible that had caloric stimulation and hearing tests been performed in every case of "middle or inner ear trouble," more cerebellopontine angle tumors would have been discovered at an earlier period. The absence of caloric responses in an ear which is partially deaf is highly significant of tumor implicating the eighth cranial nerve. Even if there be no other signs, such a patient should be suspected of having a tumor of the cerebellopontine angle, until proven otherwise.

Most of the neoplasms in this group were of the encapsulated type, such as meningioma, neurofibroma, and nonmalignant glioma. A diagnosis of tumor of the brain may sometimes be delayed because the presenting physical signs are misleading. They may indicate either a diffuse involvement of the nervous system or a falsely localizing pathological process other than tumor. One such example is cited below.

SERIES CASE NO. 79—B.S.—A fifty-eight-year-old painter was admitted to the neurologic service complaining of

headaches. From the age of fifteen to twenty-nine he suffered periodic attacks of severe occipital headaches. Since then he had been free of symptoms until two years before admission when the head pains returned. These headaches were located in the left frontal region and recurred daily. During the past nine months he experienced transient episodes of burning sensation in the right thigh, and on several occasions cramp-like seizures in both of the thigh and calf muscle groups. Three months before admission there developed moderate pain in the left shoulder which radiated to the left hand. Since then he noticed that he was unable to differentiate objects with this hand and that it became numb.

Except for the mild peripheral arteriosclerosis and blood pressure of 150/100, the systemic examination was essentially negative. Neurologic status revealed complete asteriognosis and a slight disturbance in the postural sense in the left hand. There was a positive Babinski sign on the same side. The vibratory, two-point discrimination, tactile, thermal, and pain sensibilities were normal.

Spinal puncture disclosed a clear, colorless fluid under an initial pressure of 110 mm. of water. There was no block to jugular compression. X-ray of the cervical spine showed an advanced hypertrophic spondylitis.

The clinical diagnosis was "suspected brain tumor." Under observation, the patient complained of occipital headache which radiated to the left side of the neck. Sneezing, coughing, straining, or a change in the body posture aggravated the head pains intensely. The sensory disturbances in the left hand persisted, and in addition there appeared defects in two-point discrimination sense and a slight dystaxia in the left finger-to-nose test. Since the clinical course was progressive, the suspicion of tumor of the brain became stronger, and an encephalogram was therefore performed. This revealed large amounts of air in the subtentorial and cortical regions, with the greatest collection of air over the right hemisphere, extending from the midfrontal posteriorly to the occipital region. These findings were interpreted as being due to a cortical

atrophy, which was most prominent in the right parietal lobe. The ventricular system was not visualized. This was considered to be due to an artifact. The patient made no improvement, and died suddenly two months later.

Necropsy disclosed a dural endothelioma the size of a walnut located at and just above the level of the foramen magnum and compressing the medulla oblongata and cerebellar lobe on the left side.

COMMENT: Attacks of intense headache are unusual in cerebral arteriosclerosis, and when in addition there are physical signs pointing to a well-localized intracranial lesion, one should almost always suspect tumor of the brain as the cause of the cephalalgia. The encephalograms in this case were not those usually observed in intracranial tumor, because excessive amounts of air were observed to be present over the cerebral cortex. The cortical atrophy, the asteriognosis, and other physical signs, in the presence of vascular disease suggested cerebral arteriosclerosis as the etiology for the focal lesion in the parietal lobe, especially so when excess air was found over the right parietal lobe by encephalogram. Certainly it precluded a neoplasm in that region, despite the fact that clinical judgment prompted that diagnosis. Post-mortem examination, however, proved that the localization of the lesion was erroneous. The physical signs in this patient were due to degeneration of the ascending posterior column and descending pyramidal tracts, as shown by histological examination. The pathology was found chiefly in the upper cervical cord and lower brain stem, just at the level of compression by the tumor.

As this case illustrated, it is sometimes difficult to differentiate lesions of the parietal lobe from those of the upper cervical cord. Disease of either site may yield the same physical signs. The symptoms and signs which this patient exhibited were of the type usually found in disease of the cortical sensory and motor zones, and therefore were falsely localizing. Another misleading factor was the encephalographic interpretation of atrophy of the right parietal lobe. These findings prevented the consideration

of a possible lesion in the lower brain stem. In retrospect, one may explain the encephalogram as follows: the tumor located in the vicinity of the roof of the fourth ventricle may have produced a ball valve effect: it allowed the fluid to escape but prevented air from entering the ventricles. For this reason the ventricles collapsed, and the air filling the apparent increase in the subarachnoid and subdural spaces left by collapsed ventricles produced a picture of external hydrocephalus. It is possible that the right lateral ventricle emptied more than the left, and hence when it collapsed gave an appearance of greater cortical atrophy on the right, or the picture may have been caused by a subdural collection of air and was an artifact. At autopsy there was no cerebral atrophy. On the contrary, the convolutions were distended and flattened.

Group VI

(Duration of symptoms from onset until first admission to hospital:—more than three years)

In patients who presented histories lasting over three years, the clinical course was milder than in any preceding group. As initial symptoms, impairment of vision and convulsive seizures were foremost. It was noted that in five of the six perichiasmal tumors the complaints consisted of nothing more than an intermittently progressive failure in vision for several years. Some patients visited opticians and were fitted with glasses, and not until the eyesight became notably worse, or headache or glandular disturbances became manifest in addition to the visual disturbances, was the physician consulted. This delay in seeking the physician's advice was one reason why the slow-growing pituitary tumors were not discovered until years after the onset. By the time these patients entered the hospital, all of them possessed clear-cut signs of a space-occupying lesion in the region of the optic chiasm.

As for convulsive seizures, they were initial symptoms in five of the seven tumors involving the cerebral hemispheres. The reasons for delay in diagnosis in these instances were the same as those discussed under Group V. The incidence of headache, when compared with the former groups, was

found to be greatly decreased. The head pains were mild and sporadic, and usually attributed to eye strain.

Papilledema was not as common as in previous groups. This reduction in percentage incidence may have been due to the presence of six perichiasmal tumors in this group which manifested optic nerve changes by atrophy rather than by edema. If the pituitary tumors had been excluded, the incidence of papilledema would have been raised to seventy-two per cent. Disturbances in visual field were common, because six of the tumors implicated the optic chiasm. Among other prominent physical signs were those afforded by lesions in the region of the cerebellopontine angle, manifested chiefly by disturbances in function of the brain stem and cranial nerves.

When there was a history of inflammatory disease of the brain and meninges, or if the symptoms developed directly after a head injury, the presenting physical signs were sometimes attributed to the old disease process, and thus the suspicion of tumor of the brain was obscured and the diagnosis delayed. This was especially true in cases in which the evolution of symptoms was slow and the clinical course seemingly showed no progression.

The following cases furnish examples in which the diagnosis of tumor of the brain was not made until years after the initial onset.

SERIES CASE NO. 97—B.M.—A forty-nine-year-old housewife was admitted with the history of meningitis in childhood. On several occasions during the last ten years, she had had twitchings in the muscles of the left side of the neck. Three and a half months ago she had a generalized convulsion, and on regaining consciousness she noticed a weakness of the left side of her body which lasted two weeks. Since then she has had several epileptiform seizures, originating in the left foot and hand and spreading rapidly to become generalized. During the same period, momentary twitchings in the left side of her neck and also in the muscles of the left face appeared every three or four days.

Examination revealed a moody individual—at times hilarious and at times melancholy. There was a left hemi-

paresis and concomitant mild pyramidal tract signs. She made frequent errors in identifying objects with the left hand. A mild agraphesthesia was detected on the hemiparetic side. A diagnosis of brain tumor in the right frontoparietal lobes was made, and confirmed shortly after admission by a craniotomy. The histology was that of a benign glioma.

COMMENT: The history of meningitis was a misleading factor in the interpretation of the twitchings of the neck muscles. With the latter as the only symptom for many years, it was easy to be careless and to attribute this complaint to old inflammation of the meninges. Convulsive seizures occur after a meningitic process, but not too frequently. Most significant was the strict localization of the twitching, which usually implies circumscribed cerebral pathology. In the slow-growing cerebral tumors, various forms of epilepsy were among the most frequent initial symptoms, and it was found that convulsions sometimes existed for long periods before other cerebral manifestations appeared.

SERIES CASE NO. 99—N.G.—A forty-two-year-old married man entered the hospital with the chief complaint of failing vision. He had had numerous head traumata: In 1908 he was struck by a trolley car; in 1918 he fell twenty feet from a United States dirigible into a swamp; and in 1920 he was "knocked unconscious by a blackjack." Two days after the dirigible accident, sixteen years ago, he found that the vision in his left eye was almost gone; this an army physician ascribed to chronic alcoholism. He drank a pint of "hard liquor" a day, and in 1924 he was in the Bellevue Hospital alcoholic ward. While there, he had a generalized convulsion. This also was attributed to chronic alcoholism. Except for the defective vision in the left eye, he was well and continued to work at odd jobs. Four months ago the sight in the right eye began to fail. This became progressively worse until finally he consulted a physician.

Examination revealed a moderately obese male who appeared euphoric. The general physical examination was

negative. Neurologic examination showed: slightly broad-based gait; bilateral pyramidal tract signs; the left knee jerk slightly greater than the right; and a slight tremor of the outstretched hands. There was bilateral optic atrophy. The left eye was amaurotic, and vision in the right eye was 20/40, with the visual field showing a generalized contraction and a great tendency to temporal hemianopsia. The pupillary reactions in the left eye were those expected in a non-functioning optic nerve; in the right eye the responses were normal. The left naso-labial fold was less prominent than the right.

The clinical diagnosis was suprasellar tumor.

Roentgenogram of the skull showed a slightly enlarged sella turcica, and encephalogram revealed a moderate internal hydrocephalus with defects in the left anterior horn and in the third cerebral ventricle. No definite conclusions could be drawn from these observations. The patient felt well and had no complaints except for impaired vision. A ventriculogram performed a week later revealed no new information. Since the patient hesitated to give consent for an exploratory craniotomy, he was placed on non-specific foreign protein therapy as a temporary and empirical measure. A half hour after he received an intravenous injection of typhoid vaccine there developed severe headache and he complained that his eyesight became worse. A few hours later the visual acuity became reduced to 20/200. This "reaction" gradually disappeared and within four hours he was the same as on admission. The typhoid injections were repeated and the same effects obtained. Apparently there was a definite relation between the typhoid inoculation and the subsequent prolonged reduction in the visual acuity.

Finally the patient was subjected to a right transfrontal craniotomy, and a tumor the size of a walnut was removed from the suprachiasmal region. The patient reacted poorly and died twenty-four hours later. An autopsy revealed that only a small part of the growth had been excised. There was a large cholesteatoma, "pearly tumor," which in-

filtrated the entire base of the brain and extended upward into both of the temporal and frontal lobes.

COMMENT: With the complicated history of numerous head injuries and of alcohol addiction, it was difficult for anyone to suspect a brain tumor in the early course of the disease. Furthermore, the patient was apparently comfortable and did not seek medical aid for years—until his "other eye went bad." It is well known that in an individual who is addicted to alcohol, convulsions are not uncommon, but optic atrophy is rare. The presence of optic atrophy should have prompted the consideration of an etiology other than alcohol. Brain tumor, syphilis, and multiple sclerosis are the intracranial conditions which most frequently produce atrophy of the optic nerve, and these certainly should be considered despite a history of other possible etiological factors, e.g. alcohol or head trauma. Once a brain tumor is suspected, any other etiology should be excluded by all diagnostic measures available. In this way it will be possible to make an earlier diagnosis in many instances.

SERIES CASE No. 100—A.C.—A forty-two-year-old housewife was admitted to the hospital with the following history: At twenty-three years of age there developed frequent attacks of dizziness, giddiness, nausea, and fainting. Periodically she also complained of mild headaches. The spells were attributed to a head injury which she had sustained thirteen years previously. At the age of thirty-two she was subjected to a left temporo-occipital decompression (?). She improved, and for the next eight years was symptom-free. Two years ago the fainting spells recurred. Six weeks ago, vision became impaired. Three weeks ago she had a generalized convulsion.

Examination revealed bilateral papilledema with hemorrhages, generalized hyperreflexia, and a positive Babinski sign on the left. X-ray showed an old "trephine opening" in the left parietal bone.

COURSE: An encephalogram was unsuccessful. Several days later the patient became stuporous, and an emergency subtemporal decompression was performed. The result was

a remarkable improvement with almost complete recession of the papilledema.

She was discharged as improved, and was in good health for the next ten months, when there developed a sudden attack of unconsciousness followed by a transitory right hemiparesis. Examination on the second admission revealed papilledema of 1½ D. in each eye, and a positive Babinski on the left and occasionally on the right. Smell was impaired bilaterally. Under observation, she had a generalized convulsion. An encephalogram this time revealed normal ventricular and subarachnoid systems. Since the suspected tumor could not be definitely demonstrated, the patient was discharged to the follow-up clinic. There she was observed for two years. She continued to have convulsive seizures every three months, and they usually occurred after a quarrel with her husband. There was no change in her condition except that during the last year there was noted a progressive impairment of memory.

When she was admitted a third time, the only objective signs were a slight blurring of the right optic disc margin and impairment bilaterally of the sense of smell, as on previous examinations. A third encephalogram showed a questionable shift of ventricular system to the left. More significant at this time was the visualization of a shadow interpreted as a calcification in the right subfrontal region. Based upon the latter finding, the right frontal lobe was explored and a hemangiomatous tumor involving two-thirds of the prefrontal lobe was excised.

COMMENT: This and many of the previous cases illustrate the perplexities encountered in the diagnosis of tumor of the brain. It was difficult to understand the existence of choked discs in the presence of a normal ventricular and subarachnoid system. Despite the fact that the patient had had bilateral subtemporal decompressions, changes in the ventricular system, especially anteriorly, must have occurred since papilledema existed. From this example, it is evident that normal encephalograms may be found during the symptomatic period of tumor of the

brain.* Such observations may be expected usually early in the clinical course. Since, at the present time, more cases of tumor of the brain are suspected earlier in their course, and since more aerograms are used in the study of intracranial disease in general, it is probable that more examples of normal encephalograms in the presence of verified expanding intracranial lesions will be noted. In such instances the diagnosis of tumor of the brain will depend upon clinical judgment.

In this case, the excessively long remissions in symptoms, the absence of headache, the paucity of physical signs, and the negative air studies, all tended to preclude an expanding intracranial lesion, although clinical judgment prompted what proved to be the correct diagnosis. The slow, protracted, and intermittent course was due more likely to the hemangiomatous nature of the growth. The absence of physical signs may be explained by the fact that the tumor was located in one of the "silent" areas, the right prefrontal lobe.

General Comment

The symptomatology of any type of intracranial tumor is extremely variable. Cerebral manifestations, ultimately present in most instances, vacillate in every case, especially in the incipient stages of the disease. The well-defined and clear-cut syndromes of brain tumor, as expounded in text books, are descriptions of symptoms and signs found usually in the advanced stages of the disease, when the cardinal signs of an expanding intracranial lesion are obvious and the diagnosis is simple.

The further back the clinical history is considered, the more difficult becomes the task of evaluating symptoms, particularly if there be an isolated complaint which may be common to many diseases. The difficulty becomes more pronounced when there is a lack of objective signs. Hence, the general practitioner who sees a large cross section of

* In this series of 500 patients with verified tumor of the brain, there were five cases in which the pneumoroentgenogram was reported to be normal, and yet, despite negative results, exploratory craniotomy in each case revealed a tumor.

clinical material is not to be blamed if he overlooks the presence of a brain tumor. If, indeed, he suspected the existence of one, he is to be congratulated, because early in the clinical course the consultant may be just as puzzled as the referring doctor.

From perusing the tables, it can be gathered that when the manifestations of tumor of the brain are mild and develop slowly, the chances are that the tumor will be histologically benign. As a corollary, it may be repeated that when symptoms are moderate, the diagnosis is difficult, and consequently the symptomatic period will be prolonged. Therefore, in order to shorten this period, it is necessary to reduce the difficulties involved in the detection of the disease. This can be accomplished partly by more detailed and frequent studies of the early course of tumors classified in the last three groups. And such labors will not be in vain, for not only will they improve the clinical acumen of the physician but, better still, therapeutic results will be more encouraging, since these tumors are usually of the benign encapsulated variety and do not tend to recur.

To give a detailed analysis of brain tumor, symptom by symptom, would mean to encumber this communication with a mass of approximate figures. Therefore, mention will be made of only a few of the more common primary manifestations. In all groups, the most frequent initial complaint was headache, and certainly from this observation it may be considered as an early rather than a late symptom. The headaches of brain tumor are subject to many confusing variations, and no rule can be laid down to make them characteristic. When headache is the only complaint, and unaccompanied by other manifestations or physical signs, it is indistinguishable from the role it plays as a primary symptom of other diseases. Therefore some of these patients were treated for sinus disease, for refractive errors in vision, or for "constipation," until a new sign or symptom called the doctor's attention to the fact that the underlying process was intracranial.

Whereas headache may be a symptom of disease elsewhere than in the central nervous system, convulsions as

a rule are due to disturbance in intracranial function. A frequent cause of convulsions is cerebral neoplasm. Because these seizures occur chiefly in patients with supratentorial tumors,* they have some localizing value, and when they are Jacksonian in type the lesion may be further localized to the region of the motor cortex.**

Other symptoms which have even more localizing significance are: unilateral tinnitus, impairment of hearing, of vision, of speech, of motor power, and of sensibility. Of these, only aphasia, motor weakness, and diminished sensation were found to be primary symptoms in cases with short histories. This does not necessarily imply that these symptoms were responsible for an earlier diagnosis. It may have been due to the fact that they occurred in rapidly growing neoplasms, in which other symptoms such as severe headache appeared almost simultaneously, and together these symptoms forced the patient to seek medical aid earlier than the individual who was suffering with a slow-growing neoplasm. In other words, it was the nature and rate of growth of the tumor, with proportional symptomatic expression, and not the focal value of the initial complaint, which led to an early discovery of the disease.

On the other hand, when either tinnitus or blurred vision was an initial symptom, the duration of the disease was found to be prolonged, because the organism had sufficient time to accommodate to the changes produced by such slow-growing space-occupying lesions as acoustic neuromas or pituitary tumors. In these instances the patient did

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* Convulsive seizures or their equivalents were found to be present during the course of the disease in more than one third of 380 patients with tumor located above the tentorium. In a series of 120 patients with tumor located beneath the tentorium, 16 individuals showed some form of epilepsy. Of these, 7 had Jacksonian epilepsy, and in 2 patients the Jacksonian convulsions were initial symptoms and therefore were falsely localizing and misleading in the diagnosis of location of tumor.

** While epilepsy or its equivalent is important as an attention-calling symptom and theoretically would be expected to help toward an early diagnosis, such was not the case. It was noted that as a primary symptom, convulsions were common among the late, rather than among the early, recognized tumors. (See Table II and Fig. 1.)

not appear ill, the symptoms were mild, and often the physician was either not impressed with the objective signs, or they were overlooked. The great errors sometimes committed in these cases were: neglect to examine fundi, to plot visual fields, or to test the vestibular or cochlear functions. The difficulties encountered when these examinations were made, were in the evaluation of mild disturbance in function, as for instance in the interpretation of early optic atrophy or impaired caloric responses. Undoubtedly these errors may be remedied by more frequent fundus and vestibular examinations. In this fashion the doctor will have a more lasting impression of what the normal is like, and thereby help to improve his clinical sense. If the practitioner is too busy for such detailed investigation, or if he is not sufficiently experienced to evaluate ophthalmoscopic or other observations, he should consult the specialist and demand of him a thorough examination of the eye and ear functions of the referred patient.

Mental changes occur sooner or later in the course of most patients with tumors located above the tentorium, and less frequently in patients with tumors located below the tentorium. As initial symptoms, mental changes were found more commonly in patients with supratentorial tumor whose histories were of brief duration and were usually to be associated with other symptoms. Mental changes, when unaccompanied by physical signs other than those of intracranial hypertension, had localizing value insofar that they were more apt to be found in patients with tumor above rather than below the tentorium. This was especially true in those cases in which mental disturbances were primary manifestations.

As an initial symptom of brain tumor, vomiting was found to be uncommon. It usually occurred in advanced stages of the disease and was a frequent late symptom. When vomiting was persistent, wasting and loss of weight appeared as sequellae.

The symptoms during the course of a tumor of the brain are described in many text books as being progressive in character. In this study, such was frequently not the case;

the course was found to be characterized often by long remissions, during which period the patient was sometimes free of all subjective and objective manifestations. Complete regressions of hemiplegias, papilledema, aphasia, or other objective signs were observed in many patients of this series. In some instances, the clinical course was similar to that of cerebral thrombosis or of encephalitis, where improvement in symptoms is the rule. During the stage of improvement in a patient with tumor of the brain, the physician may be disinclined to regard the case as that of intracranial tumor, and label the disease as "vascular" or "inflammatory" simply because the patient recovered from his attack of cerebral symptoms. It must be reemphasized that remissions in symptoms in patients with tumor of the brain are common, and therefore, when an improvement in signs or symptoms does occur in the course of the disease, it should not be argued that because of the improvement the diagnosis of tumor is not likely.

A majority of the patients had at least one or more physical signs when admitted to the hospital, and in many cases the signs were adequate for localization. In those in which the tumor could not be localized, aerograms were of great aid. When physical signs were lacking, the diagnosis was invariably postponed until pneumoroentgenogram proved the existence of a tumor.

There is no point in discussing the characteristics of every abnormality noted in the examination made on admission to the hospital. The only textbook objective manifestation of tumor of the brain which needs special comment here is choked disc. All of the patients but one had eye ground examinations. Forty-eight per cent of them showed papilledema of different intensities: some, early swelling; others, advanced choking with secondary optic atrophy. The incidence among twenty-three patients with infratentorial tumor was fifty-six per cent, and among seventy-seven patients with supratentorial tumor it was forty-five per cent. These figures illustrate that the incidence of papilledema in tumor of the brain is not as

common as it once was thought to be.* From the foregoing, it is evident that papilledema is not a necessary criterion for a diagnosis of brain tumor. The decreased percentage in papilledema is probably the result of earlier clinical diagnoses. Undoubtedly, the more frequent use of aerograms decreased the duration of the clinical course in many suspected cases. Our conception of the symptoms of tumor of the brain must be changed from the classical descriptions, where the emphasized symptoms are those found in advanced cases. When more tumors of the brain will be discovered sooner, naturally their symptom-complexes will change; the syndromes will be descriptions of the disease at a period earlier than they have been described. In this way, the physician will train himself to make still earlier diagnoses. Aerographic study will require most delicate interpretation; indeed, the encephalogram may even appear normal, and in spite of the negative pneumoroentgenograms of the skull, the keener clinical sense will espy the presence of an intracranial tumor.

It will be seen from this study that there is no classical syndrome of tumor of the brain. There is no one symptom upon which stress can be laid in making the diagnosis. The diagnosis depends entirely upon the physician's ability to weigh the severity and nature of the symptoms in each individual case, upon his keenness in detecting objective signs—no matter how slight, and to appreciate their importance in connection with the subjective complaints of the patient. If a diagnosis cannot be made, there then must follow a period of careful observation and the use of physical methods, such as encephalography, to either substantiate or disprove the presence of tumor. It may also happen that even these laboratory methods may give negative results, and despite this the progress of symptoms both subjective and objective may lead to the diagnosis of a cerebral neoplasm, and warrant surgical interference at

* In support of this statement, a study of a series of 500 verified tumors of the brain revealed that the percentage of choked discs among all types of intracranial tumor decreased each year from 1915 to 1935, and that the greatest decrease occurred in the last three years.

an early stage. In other words, the diagnosis of a cerebral neoplasm depends even today upon the ART OF MEDICINE, assisted by whatever laboratory procedures are available.

SUMMARY

A review of the initial symptoms and early course of the last one hundred of a series of five hundred patients with tumor of the brain revealed the following:

1. Headache, mental changes, and disturbances in mental speech (aphasia) were the most frequent primary symptoms in patients with rapidly-growing tumors; these symptoms were severe and disabling, attracting the early attention of the patient and the doctor and therefore predisposed to the recognition of the disease shortly after its onset.

2. Convulsions and visual disturbances were the most frequent primary symptoms in patients with slow-growing tumor; these symptoms were usually mild, transitory in character, and unaccompanied by other symptoms, and hence the tumors in these instances were not discovered till late.

3. The course of the disease was frequently characterized by partial or complete remissions in subjective as well as objective symptoms.

4. Papilledema was found to be present in forty-eight of the last one hundred patients studied: in thirty-five of the seventy-seven patients with supratentorial tumor, and in thirteen of the twenty-three patients with infratentorial tumor.

5. The incidence of occurrence of papilledema was found to be high among patients with clinical histories of relatively long duration, and low among the cases with brief duration, because in many of the latter the tumors were recognized before papilledema appeared.

6. There was a progressive decrease in the percentage of incidence of papilledema among patients with verified intracranial tumor admitted each year from 1915 to 1935; the greatest decrease occurred in most recent years. This observation may be explained by a wider and more frequent

use of pneumoroentgenograms, leading to an earlier diagnosis of tumor of the brain in general—before the appearance of choked disc.

7. The more frequent recognition of tumor of the brain earlier in its course will change the older text book descriptions of symptom-complexes observed late in the course of the disease to the newer descriptions of syndromes observed earlier in the disease.

8. Normal encephalogram during the course of a tumor, later verified by operation or necropsy, was found in five instances.

9. Several case histories were cited to illustrate the various problems encountered in the early diagnosis of tumor of the brain. The correct diagnosis in most instances depended upon clinical judgment, aided by whatever laboratory procedures available.